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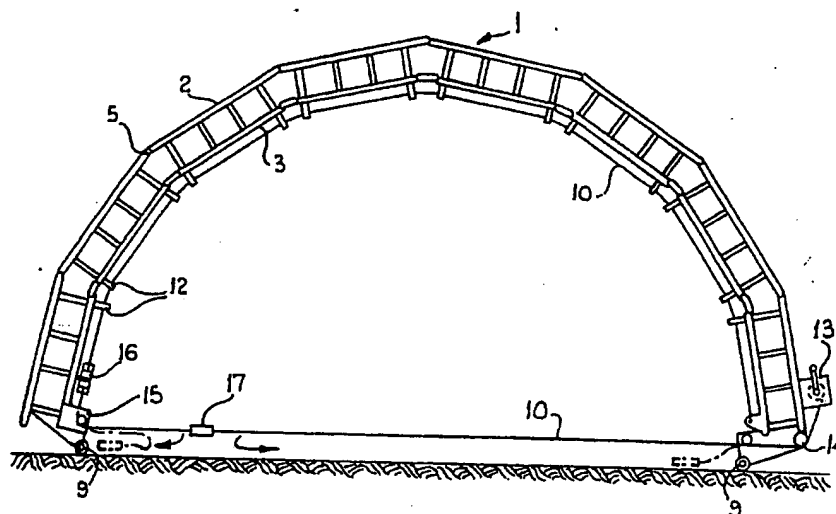
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(54) Title: ARCHED STRUCTURE



(57) Abstract

An erectible and collapsible arched structure comprises a plurality of segments (1) which are connected end-to-end so as to extend longitudinally as an arched form in an upright plane when erected, a hinge connection (5) being provided between adjacent segments (1) with a hinge axis (X-X) that extends laterally of said upright plane, abutment means (6, 7, 8) being provided at the ends of adjacent segments spaced inwardly of the hinge axis (X-X) towards the underside of the arched form so as to cooperate in compression when the arched structure is erected, and a cable (10) extending longitudinally of the arched structure between end segments thereof along a path spaced inwardly of the hinge axes (X-X) and cooperating with each segment (1) so that when tensioned it holds the structure in its erected arched form. The cable returns across a chord of the arch to one end provided with a winch (13). Restraining ties (6) are provided between adjacent ends of the segment so as to limit the hinging action when the structure is collapsed.

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ARCHED STRUCTURETechnical Field

This invention relates to an erectible and collapsible arched structure suitable for easy and rapid assembly and erection for temporary use, for example, in supporting a roof or cover. In particular, there is a military application for such a structure for rapid deployment in supporting a cover or camouflage net over military equipment such as tanks or aircraft.

Arched structures have been proposed comprising a plurality of segments which are connected end-to-end so as to extend longitudinally as an arched form in an upright plane when erected. Hinge connections are provided between adjacent segments with axes extending laterally of said upright plane, and abutment means are provided at the ends of adjacent segments so as to cooperate in compression when the arched structure is erected. A cable extends longitudinally of the arched structure and cooperates with each segment so that when tensioned, it holds the structure in its erected arched form. However, these proposed arched structures are not easy to erect, and are not designed to be readily collapsible so that

they can be removed and re-erected elsewhere.

### Disclosure of the Invention

An object of the present invention is to provide an arched structure which is readily erectible and collapsible.

This is achieved according to the invention by providing an arched structure comprising a plurality of segments which are connected end-to-end so as to extend longitudinally as an arched form in an upright plane when erected, a hinge connection being provided between adjacent segments with a hinge axis that extends laterally of said upright plane, abutment means being provided at the ends of adjacent segments spaced inwardly of the hinge axis towards the underside of the arched form so as to cooperate in compression when the arched structure is erected, and a cable extending longitudinally of the arched structure between end segments thereof along a path spaced inwardly of the hinge axes and cooperating with each segment so that when tensioned it holds the structure in its erected arched form, characterised in that winch means is provided on the arched structure which is operable

to tension and shorten the cable between said end segments so as to erect the structure into its arched form, and to extend the length of the cable between said end segments so as to allow the structure to assume its collapsed form.

The winch means and cable serves to lift the segments into their erected arched form, and can be maintained in a tensioned state once erected to lock the ends of the arch a fixed distance apart and prevent it from collapsing, or at least to serve as a safety feature to prevent collapse if additional means are provided to fix the ends of the arch in position.

The cable, as well as extending along the length of the arch, may extend across a chord of the arch between its ends so that both ends of the cable are secured to one and the same end of the arched structure. - Tensioning of the cable with the winch means will then apply a further force directly between the ends of the structure to pull them together. However, that section of the cable between the ends of the structure may be adapted so that it can be uncoupled once the structure is erected leaving the rest of the cable still

fastened between its ends. The floor space within the erected arch is therefore left unimpeded.

In order that the cable is of maximum affect, it is located at a maximum distance inwards from the hinge axes, preferably being located inwards of the abutment means.

The arched structure will usually be substantially symmetrical about an upright central axis when erected. The central shape of the arched form will be determined by the lengths of the segments and the angles defined between adjacent segments by the abutment means. If the segments are all substantially the same length and the abutment means define a common angle between adjacent segments, then the arched form will lie on a circle. However, alternative variations are possible.

According to a further feature of the invention, restraining ties are provided between adjacent ends of the segments so as to limit the hinging action therebetween when the structure is collapsed, thereby holding the segments in a predetermined form above the ground, supported at

both ends, when fully collapsed.

The restraining ties may each take the form of a slotted plate with a pin on each segment engaging a slot in the plate that accommodates the hinging action but has one end that the pin engages when the structure is collapsed. The pins on adjacent segments may engage opposite ends of a common slot in the plate when the structure is collapsed.

Preferably, the abutment means and restraining ties may be combined, for example, by arranging that the pins of adjacent segments in a common slot, as described above, also abut one another when the structure is in its fully erected form.

Ground engaging wheels may be provided at each end of the structure so as to make it mobile and facilitate erection of the structure.

#### Description of the Drawings

The invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a side elevation of an arched structure according to the invention in its erected state,

Figure 2 shows the hinge connection between adjacent segments of the erected arched structure in Figure 1,

Figure 3 shows a side elevation of the arched structure of Figure 1 when collapsed,

Figure 4 shows the hinge connection between adjacent segments of the collapsed arched structure in Figure 3, and

Figure 5 shows a plan view of the arched structure as collapsed in Figure 3.

#### Mode of Carrying Out the Invention

The illustrated arched support consists of eight similar segments 1 which are each hingedly connected end-to-end to an adjacent segment so as to extend longitudinally as an articulated structure. Each segment 1 consists of a rectangular framework of three upper longitudinally extending elongate members 2 spaced



apart laterally alongside one another, and three lower longitudinally extending elongate members 3 similarly arranged below the upper members 2, with all of these elongate members 2, 3 interconnected by ties and braces 4, as shown in the drawings, to form a rigid framework.

Adjacent segments 1 are hingedly connected together by pivot pins 5 which interconnect the respective ends of the upper elongate members 2 and define a common lateral hinge axis X-X, shown in Figure 5. The hinging movement of adjacent segments 1 relative to one another is limited by slotted plates 6 which each interconnect a respective pair of adjacent ends of the lower elongate members 3. A pin 7 extends laterally from the end of each lower member 3 and engages within a longitudinal slot 8 at one end of a respective plate 6 so that the pins 7 at the ends of adjacent pairs of lower members 3 are free to move longitudinally within their respective slots 8 as the segments hinge relative to one another.

At one extreme collapsed position, the pins 7 engage the outermost ends of the slots 8, as shown in Figure 4, and the plate 6 serves as a

restraining tie to hold the segments in this collapsed position. At the other extreme erected position, the pins 7 engage the innermost ends of the slots 8, as shown in Figure 3, and the plate 6 serves as an abutment member loaded in compression to hold the segments apart in this erected position. The geometry of the hinge axis X-X, the pins 7 and slotted plates 6 is such that adjacent segments hinge through a predetermined angle between the collapsed and erected positions which is consistent with the number of segments 1 and the overall shape of the arched support which is required. As shown in the illustrated example with eight similar segments which assume a substantially horizontal state in the collapsed position, and the geometry of the plates 6 and pins 7 all the same, each pair of segments 1 hinge through 22.5 degrees between their extreme relative positions. In alternative embodiments, the spacing of the innermost ends of the slots 8 in each plate 6 could be different from one plate to another so as to vary the shape of the erected arched structure.

The arched structure is supported on wheels 9 at its extreme ends which are connected to the

framework of the outer segments 1 at each corner and in the centre. This arrangement is such that the structure is mobile both when collapsed and erected. If desired the wheels 9 can be caster wheels so that maximum manoeuvrability is provided.

In order to erect the arched structure from the collapsed state, a cable 10 is provided which extends longitudinally of the structure between its ends, and is spaced inwardly of the main framework of the segments 1. This cable 10 extends through apertures 11 in the ends of extensions 12 which project downwardly from the lower side of the segments adjacent to the end of each. The cable 10 is tensioned to erect the arched structure by a winch 13 at one end which winds in one end of the cable. The cable extends from the winch 13 round a pulley 14, across the space beneath the structure, and round a pulley 15 at the other end of the structure before passing through all of the apertures 11 in the extension 12 back to the end with the winch, where it is connected to the framework. Winding of the winch therefore applies a force directly between the ends of the structure which helps draw them

together as the structure is erected. Tension in the cable also exerts a hinging moment on the segments 1 through the extensions 12.

A lock device 16 is provided at an intermediate point in the length of the cable 10 which is located adjacent to the opposite end of the structure from the winch when the structure is erected, as shown in Figure 1. This lock device 16 is fastenable to the framework of the end segment, for example, by a pin engaging aligned holes in the lock device and a plate on the framework. Furthermore, a releasable connector 17 is provided in the cable 10 at a point located between the lock device 16 and the winch 13 so that this can be released once the lock device is fastened to the framework so that the length of cable extending directly between the ends of the structure can be moved clear of this space to allow unrestricted access.

Although, only one cable 10 and winch 13 has been described above, it will be appreciated that more than one can be provided depending on the size and width of the structure. For example, three cables and winches are shown in the illustrated

embodiment.

In an alternative embodiment of the invention, the slotted plate 6 may be replaced by a similar plate having just a single slot 8 instead of individual slots for each pin 7, as shown in the illustrated embodiment. The ends of the respective lower members 3 are the pins 7 would then abut to define the erected position of the segments.

It will be appreciated that an arched support according to the invention may be manufactured as a "knock-down" kit which can be readily stored or transported to a site where it is required for use, the frameworks of the segments then being assembled and hinged together locally ready for use. When no longer needed, the whole structure can be disassembled and packed away ready for future use.

CLAIMS

1. An erectible and collapsible arched structure comprising a plurality of segments which are connected end-to-end so as to extend longitudinally as an arched form in an upright plane when erected, a hinge connection being provided between adjacent segments with a hinge axis that extends laterally of said upright plane, abutment means being provided at the ends of adjacent segments spaced inwardly of the hinge axis towards the underside of the arched form so as to cooperate in compression when the arched structure is erected, and a cable extending longitudinally of the arched structure between end segments thereof along a path spaced inwardly of the hinge axes and cooperating with each segment so that when tensioned it holds the structure in its erected arched form, characterised in that winch means (13) is provided on the arched structure which is operable to tension and shorten the cable (10) between said end segments (1) so as to erect the structure into its arched form, and to extend the length of the cable (10) between said end segments (1) so as to allow the structure to assume its collapsed form.

2. A structure as claimed in claim 1 in which the cable (10) extends beneath the structure between the end segments (1) so that both ends of the cable are secured to one and the same end of the arched structure.

3. A structure as claimed in claim 2 in which a lock device (16) is provided at an intermediate point in the length of the cable (10) and is located at the opposite end of the structure from the winch means (13) when the structure is erected and is fastenable to the structure at said opposite end, thereby to maintain the structure erect.

4. A structure as claimed in claim 3 in which a releasable connector (17) is provided at a point in the cable (10) between the lock device (16) and the winch means (13).

5. A structure as claimed in any one of the preceding claims in which the cable (10) is located inwards of the abutment means (6, 7).

6. A structure as claimed in any one of the

preceding claims which is substantially symmetrical about an upright central axis when erected, and all segments (1) are of substantially the same length.

7. A structure as claimed in any one of the preceding claims in which the abutment means (6, 7) defines an angle between adjacent segments (1) in said upright plane which are substantially the same throughout the structure.

8. A structure as claimed in any one of the preceding claims in which restraining ties (6) are provided between adjacent ends of the segments (1) so as to limit the hinging action therebetween when the structure is collapsed.

9. A structure as claimed in claim 8 in which the restraining ties (6) limit the hinging action so as to hold the segments in a predetermined form above the ground, supported at both ends, when fully collapsed.

10. A structure as claimed in claim 8 or 9 in which the restraining ties (6) each take the form of a slotted plate with a pin (7) on each segment

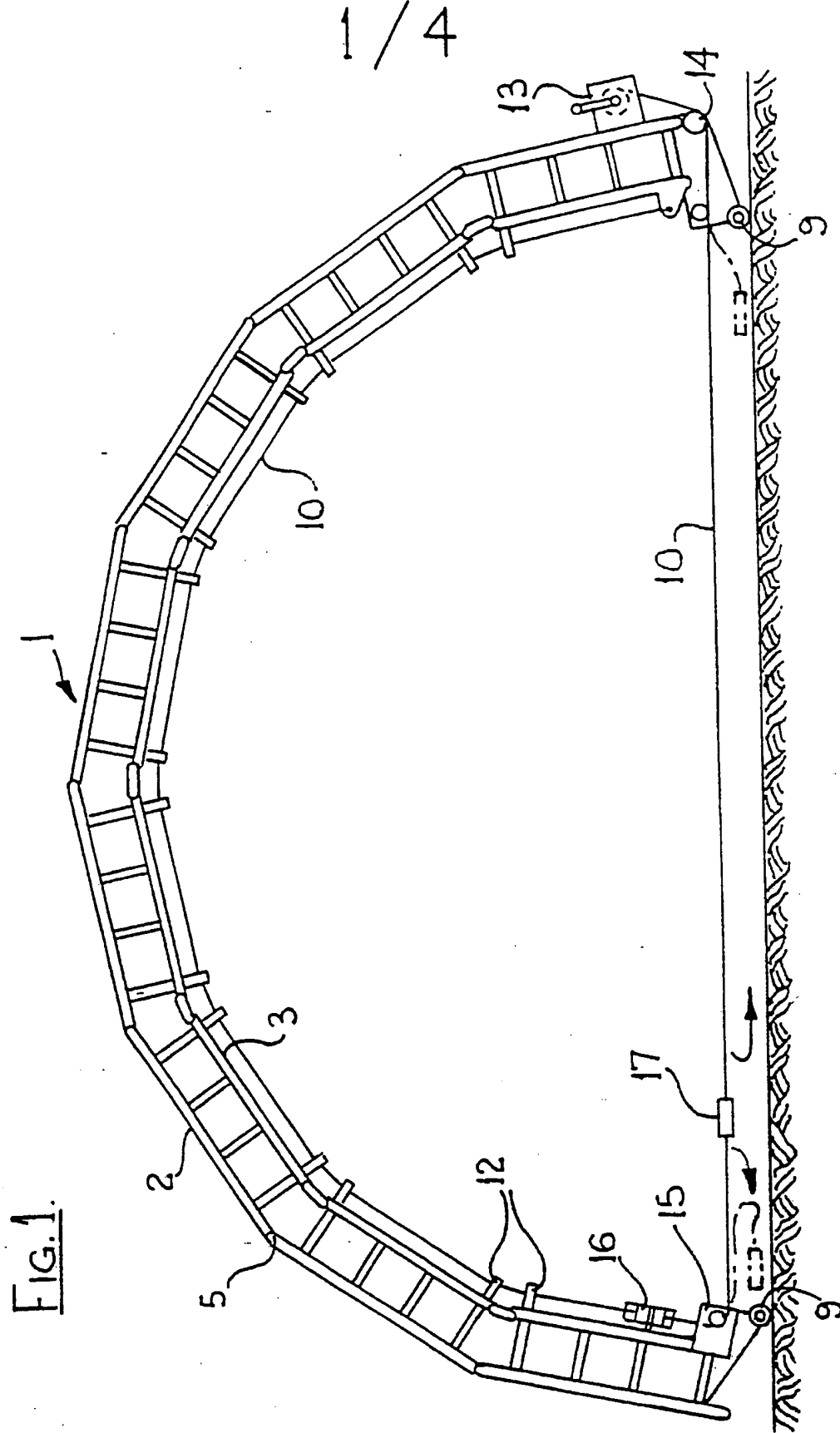


(1) engaging a slot (8) in the plate that accommodates the hinging action but has one end that the pin (7) engages when the structure is collapsed.

11. A structure as claimed in claim 10 in which the pins (7) on adjacent segments (1) engage opposite ends of a common slot (8) in the plate when the structure is collapsed.

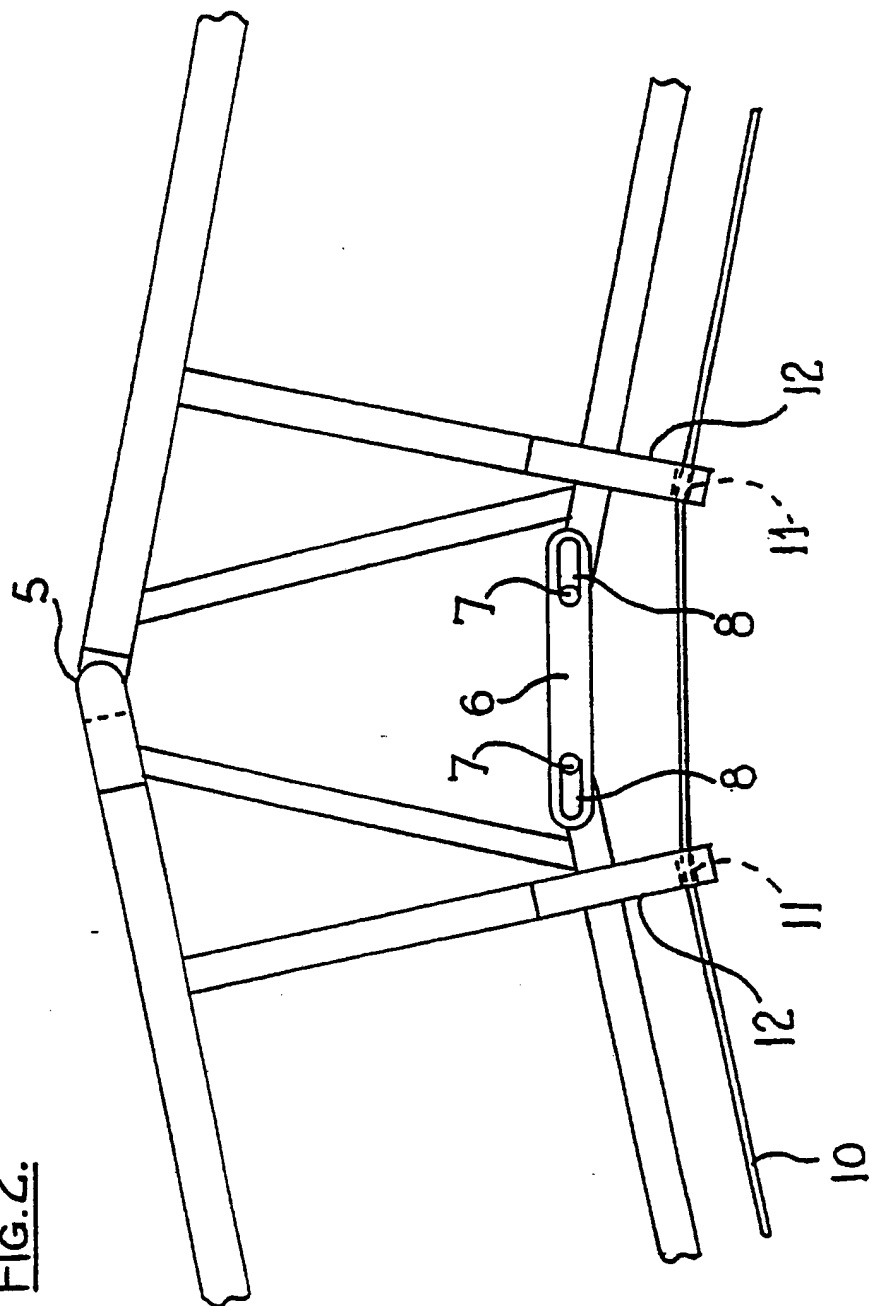
12. A structure as claimed in any of claims 8 to 11 in which the abutment means (6, 7) and restraining ties (6) are combined by arranging that the pins (7) of adjacent segments (1) in a common slot (8) abut one another when the structure is in its fully erected form.

13. A structure as claimed in any one of the preceding claims in which ground engaging wheels (9) are provided at each end of the structure.



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Fig.2.



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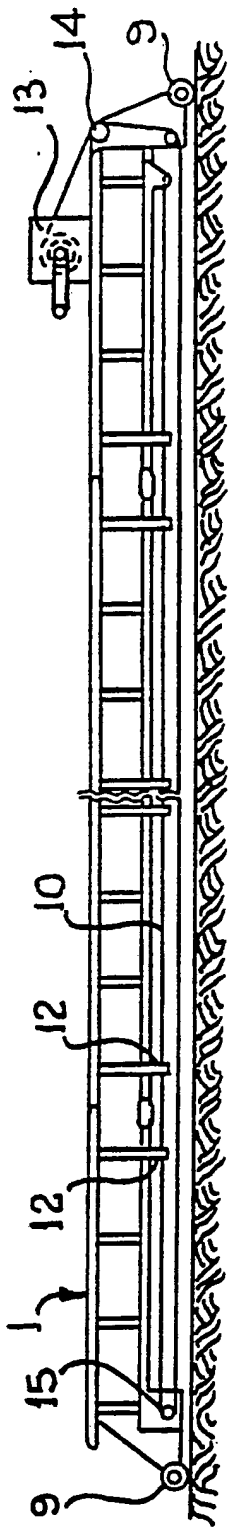


FIG. 3.

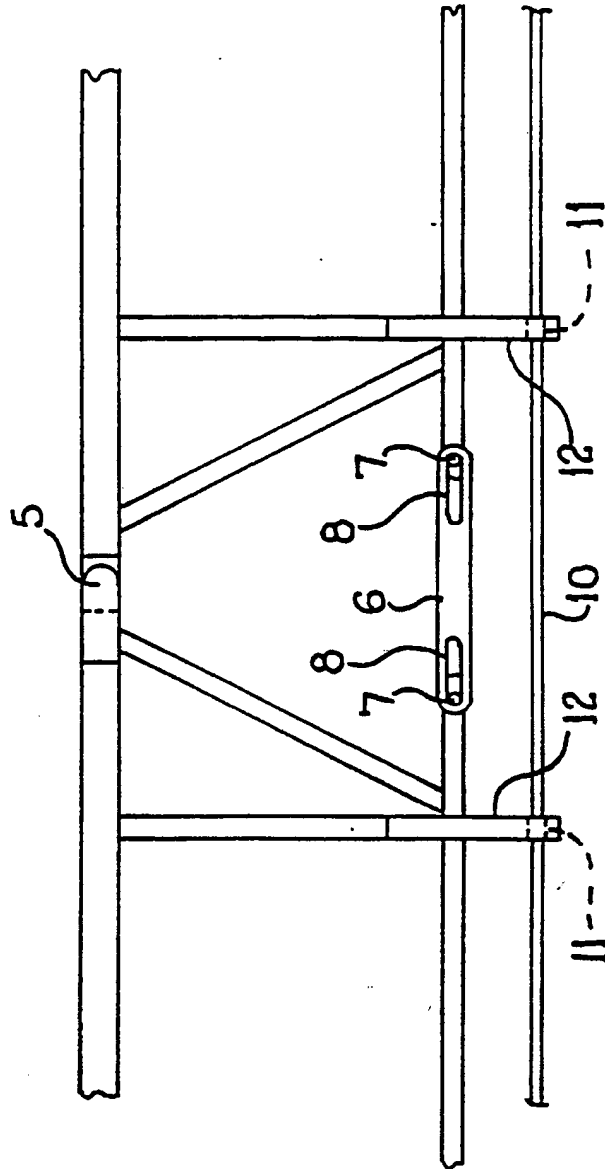
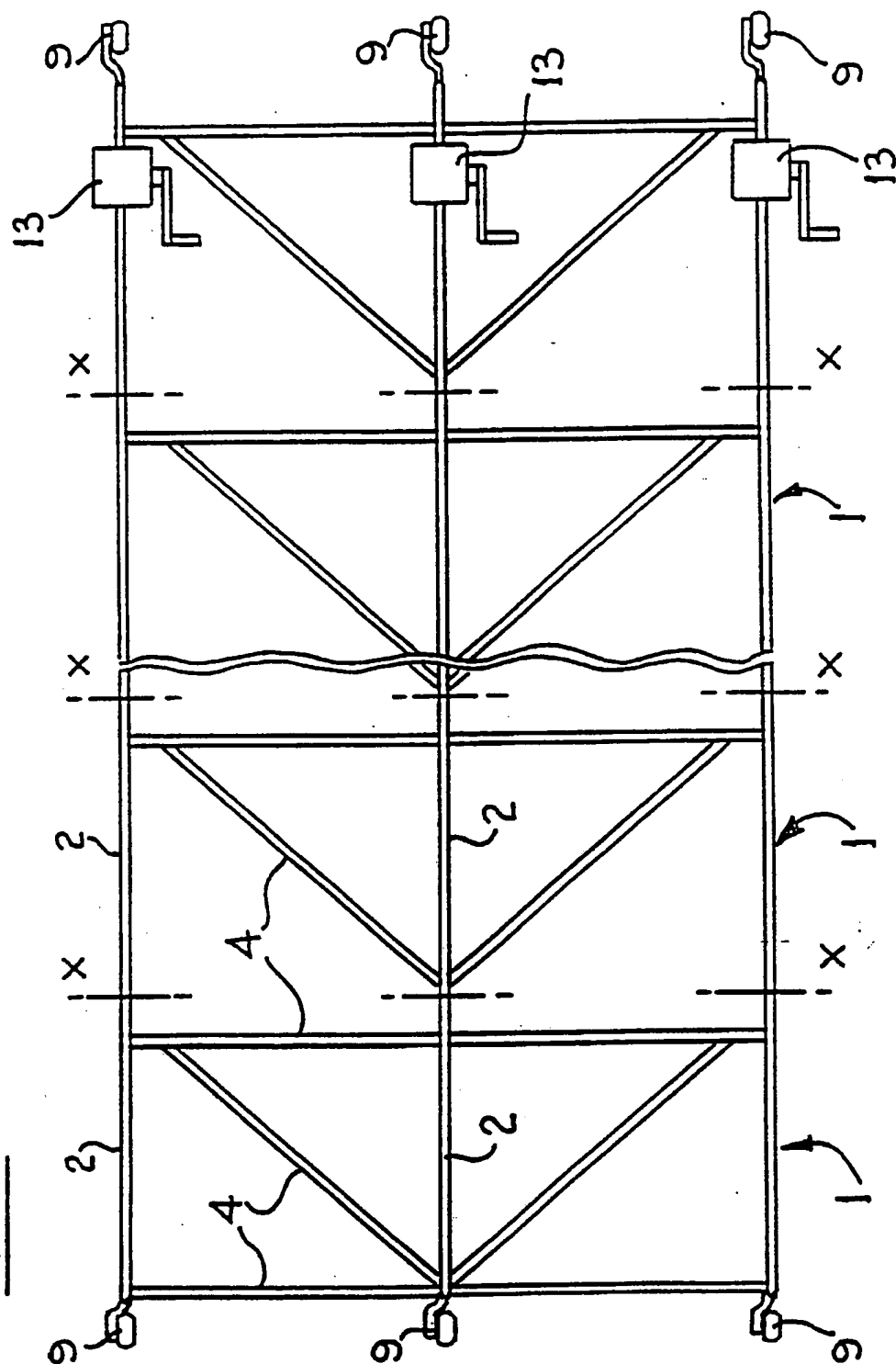


FIG. 4.

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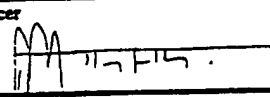
FIG. 5.



## INTERNATIONAL SEARCH REPORT

PCT/GB 92/00635

International Application No

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 E04H15/36; E04B1/32		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	E04H ; E04B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	WO,A,9 012 167 (HARDING) 18 October 1990	1,5
Y	see page 5, line 19 - page 7, line 20; figures 1-8	2,6,7
Y	--- AU,D,5 668 473 (SINNAMON) 12 December 1974	2,6,7
	see page 2, line 33 - page 3, line 69; figure ALL	
A	--- GB,A,680 294 (WALLER) 1 October 1952	8-10
	see page 3, line 37 - line 52; figure 3	
<p><sup>10</sup> Special categories of cited documents : <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
09 JULY 1992	16 JUL 92	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	BARBAS A. 	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO. GB 9200635  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9012167	18-10-90	None	
AU-D-5668473	12-12-74	None	
GB-A-680294		None	

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